APPENDIX C

ADDITIONAL WOOD POLE DATA

C-1. Related pole data.

This appendix provides related data on wood poles which is not readily available in regard to general factors affecting pole life. Understanding the influence of these variables will help maintenance workers understand what contributes to the life of a wood pole installation both by the quality of its initial treatment and by the actions of the environment in which the pole is installed.

C-2. Why wood poles fail.

Wood poles generally fail because of pest damage or from wood-rotting fungi. A good preservative treatment discourages both. The ability of treated poles to resist deterioration depends principally upon the thoroughness and quality of the original preservative treatment and to a lesser extent on the type of wood and local climatic conditions.

C-3. Initial installation.

Maintenance personnel should be familiar with how much pole life is influenced by the quality of the preservative treatment. It is recommended that replacement wood poles and crossarms be produced by a treatment plant which is under the National Rural Electric Cooperative Association's (NRECA) wood quality control (WQC) program. Each wood pole and crossarm should bear the WQC symbol. This program was set up by the Rural Electrification Administration (REA) with NRECA to ensure a source of high quality treated wood products for utility company purchasers. This source should eliminate wood products that have been damaged or improperly prepared by a treatment plant.

a. Pole *damage.* Wood undergoing treatment can be damaged by too high a temperature or pressure or both; use of overseasoned wood; undetected defects; and improper handling or storage methods.

b. Improper preparation. Shallow or erratic penetration, low preservative retention, and inadequate toxicity and permanence of preservative occur when the wood treatment plant has an inadequate quality control program resulting in inaccurate, inadequate, or uneven treatment cycles during the treatment process. Most wood preservatives are restricted-use pesticides which can only be applied by certified applicators.

C-4. Types of wood.

Overhead electric distribution circuits and equipment are most commonly supported on wood poles of southern yellow pine and western red cedar. Douglas fir, western larch, red or jack pine, lodgepole pine, or ponderosa pine are used where available.

C-5. Influence of local conditions.

Preservative treatment only delays the ravages of pests and fungus, and does not eliminate pole decay. Local conditions will have a direct influence on the speed of decay and directly affect the mechanical strength of poles. Pole strengths must be maintained above definite minimum requirements to meet safety requirements.

a. Adequate strength. Poles must be maintained at all times to withstand the applicable loads resulting from the conductors and equipment weights carried, as well as the influence of weather conditions. In the United States, three loading districts based on weather conditions are recognized by the NESC. These loading districts are designated as light, medium, and heavy. Loading districts are indicated on the general loading map of the United States contained in the NESC.

b. Cause of damaging actions to wood poles. Insects and other pests can attack poles in most geographical areas. Termites, wood-boring beetles, and even carpenter bees and ants, may cause serious damage. Poles that are heavily infested with insects attract wood-damaging birds, such as woodpeckers. Fire and improper handling of poles during installation or maintenance can also cause damage.

(1) *Termites and other insect damage.*

(a) Termites. Two classes of termites attack poles: the ground-dwelling termites, which are found in practically every state; and the dry-wood (or aerial) termites found only in the south. Generally, the same measures taken to prevent decay-good preservative treatment-also prevent termite attack.

(b) Ants. Black and brown carpenter ants are often a serious problem, especially in cedar poles in the northeastern states. The ants enter the pole through a check (separation along the grain of the wood occurring across the annual rings) or injury and construct galleries that seriously weaken the pole near the ground line. Unlike termites, they do not use the wood for food.

(c) Control. Ants may be effectively destroyed by injecting about one pint (0.5 liter) of an approved termite repellant into the interconnected galleries. This can be done with an ordinary grease

gun, fitted with a suitable nozzle, applied at two or three holes bored to connect with the galleries. Occasionally, ground-dwelling termites are found in otherwise sound poles, and they may be destroyed in the same manner.

(d) Certified *personnel.* Use of a certified pest control company and personnel or entomologist to perform treatments which employ insect repellent chemicals. Personnel certification must be by the state in which the facility is located.

(2) *Woodpecker damage.* Many ideas have been tried out by pole users in an effort to outwit these birds, but nothing has been proven to be economically justifiable. Considerable study is in progress on the problem. In the meantime, two points are worth keeping in mind.

(a) Direct *damage.* There is some tendency to exaggerate the damage done by woodpeckers. The breaking point of a pole is near the ground line. Most woodpecker attacks occur above the midsection. The Rural Electrification Administration (REA) indicates that damaging actions which cause less than a 25 percent wood loss above the midsection probably will not result in a serious loss of pole strength. With consideration to wind loading, woodpecker holes are less damaging when on wire-line connection faces rather than on nonwire-line pole faces.

(b) Secondary damage. Woodpecker holes often expose untreated wood to moisture and the spores of fungi, with resultant decay that weakens the pole far beyond that done by the holes themselves. A woodpecker selects a pole only by chance, and that first hole invites further attack by other woodpeckers. For these reasons, it is good maintenance practice to seal these holes. Epoxy formulations are available for repair of bird damage.

(c) Nest poles. Experience at some facilities shows that if a nest pole needs to be removed and replaced, the new pole will be singled out for a new nest. Based on facility experience, it may be better to leave the nest pole standing and transfer conductors to an adjacent new pole.

(3) *Fire damage.* Many poles are lost or damaged as a result of fires. Freshly treated poles can often be easily ignited, but after a few months in service they become more resistant to fire. Where grass fires are of annual occurrence, the grass around poles should be eliminated in the spring with commercial weed killers. A water-soluble type soil-sterilant is recommended, which will keep weeds down for a 3-year period.

(4) *Other damage.* Poles can be damaged by improper loading and storage methods or by poor field installation.

(a) Unloading. Poles should be unloaded by approved methods. Instructions on unloading and hauling poles are given in “The Lineman’s and Cableman’s Handbook.” Care should also be used in unloading from trucks or pole trailers and in all handling, both to prevent damage to the workers and to the pole. Some poles may break or crack when subjected to sudden shock but would have had adequate strength for normal use. Pointed tools are not recommended for handling poles; but if necessary they should be applied only near the butt end.

(b) *Storage.* Poles should be installed as rapidly as possible after they are received as poles deteriorate even in storage. Proper storage methods can reduce this to a minimum. Poles should be stored in a well-drained yard devoid of vegetation and debris and on skids (preferably metal) 30 inches (75 centimeters) above ground. Spacing the poles to provide adequate ventilation is necessary. To protect the poles from disease, spacing blocks should be clean treated timber. Pole stacks should be adequately supported to prevent bending, crushing, or distortion of poles. All poles should be turned to expose different areas to rain and sun every 6 months. Additional preservative should be applied as needed, particularly on former support bearing areas. Poles stored for more than 1 year should be given a groundline supplementary treatment.

(c) Field installation. AI1 boring and gaining should be done by the supplier before the original treatment. When it is necessary to do any framing or boring of treated poles in the field, any gains or holes should be promptly and carefully treated with generous applications of an approved preservative. Unused holes should be filled with an approved preservative and sealed with a tight-fitting treated plug.

c. Wood-rotting fungi and decay. All species of fungi weaken wood. Once fungi have gained a foothold, the destructive attack continues at an increasing rate over a larger and larger area. By the time decay to the depth of ¼-inch (0.6 millimeters) is detected, the loss of strength has gone to the depth of an inch (25 millimeters) or more. Speed of decay is affected by moisture, temperature, type of soil, and optimum time element.

(1) *Moisture.* All growing fungi require a moisture content in the wood of 25 to 50 percent, though some forms of brown rot occur when little moisture is present and are sometimes called “dry rot.” Wood continuously wet does not decay, due to the exclusion of air. When wood is dry, fungi become dormant, but start growing again when the required moisture conditions are restored. Due to the narrow range of moisture requirements, wood alternately

wet and dry is commonly subject to rapid decay, a possible occurrence in warm regions with frequent rainfall.

(2) *Temperature.* The temperature range of rapid fungus growth is 75 to 95 degrees F (24 to 35 degrees C). As temperature decreases below 75 degrees F (24 degrees C), the rate of growth decreases, and at about 40 degrees F (5 degrees C) fungi become dormant but resume growth when the temperature increases.

(3) *Type of soil.* A porous soil, and one slightly acid (hydrogen ion concentration or pH of 4 to 6) and containing certain mineral requirements, promotes most rapid decay. The growth of fungi usually stops about 5 feet (1.5 meters) below the surface of the ground due to lack of air, and in compact soil decay usually extends no deeper than 2 feet (0.6 meters).

(4) *Optimum time element.* Since temperature and moisture are the most important considerations, the time element, or number of days in the year when optimum decay conditions prevail, becomes an important factor. In southeastern states, for example, fungi are generally more active throughout a greater part of the year than in other parts of the country, but local topography can affect the situation in small areas.

C-6. Decay patterns.

The pattern of decay varies dependent upon the influence of each of the preceding pole failure factors and results in the following types of damage.

a. Surface damage. Surface damage from external decay above the ground line is more or less visible, but digging is required to reveal damage below the ground line.

(1) *External decay.* In any species of timber, external decay results from a poor preservative treatment or too low an absorption of preservative. In older poles, it is a consequence of gradual loss of most of the preservative in the sapwood through leaching, evaporation, and chemical change. In most cases, the first occurrence of decay will be just below the ground line. This is where the conditions of moisture, temperature, air, and the absence of direct sunlight are most favorable to the growth of fungi. Unfortunately, this is a portion of the pole usually hidden from view and most affected by a reduction in strength.

(2) *Loss of strength.* Loss of strength at the ground line is critical because this part of the pole is stressed the most in bending. Figures C-l and C-2 show the results of surface decay on a 12-inch (300-millimeter) diameter pole. Any pole with extensive decay, as shown in these figures, is dangerous and should be replaced immediately.

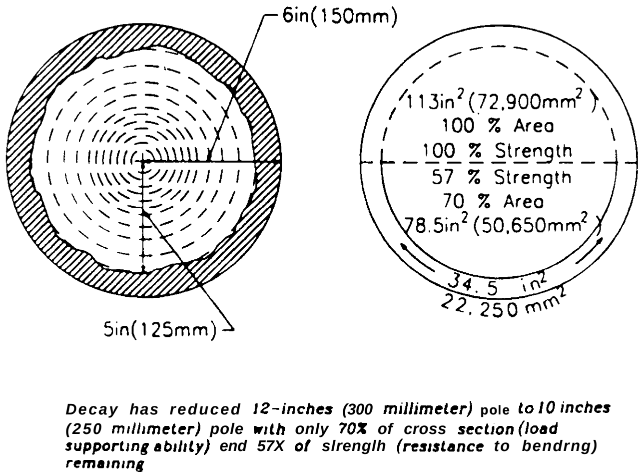


Figure C-l. Twelve-inch (300-millimeter) pole with l-inch (25-millimeter) surface decay

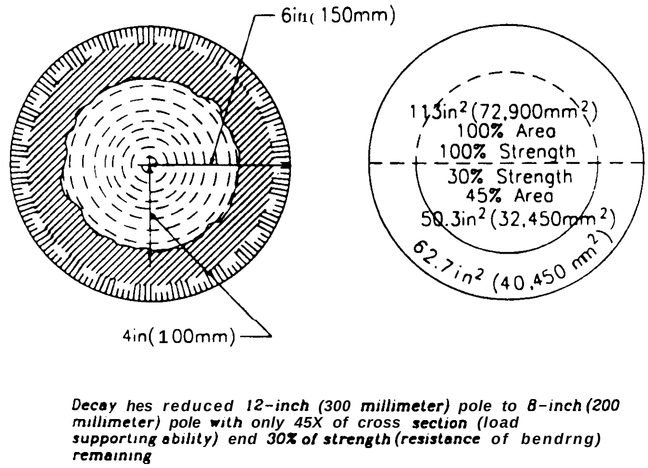
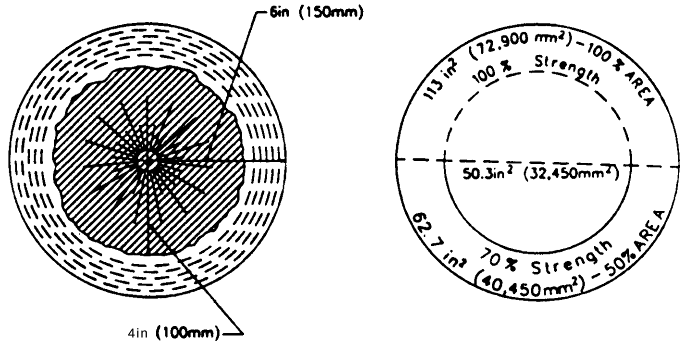


Figure C-2. Twelve-inch (300-millimeter) pole with 2-inch (50-millimeter) surface decay

b. Interior damage. Interior damage from internal decay that occurs in the interior of the pole is known as "heart rot" or "hollow heart" and requires sound testing or probing to reveal its existence and extent.

(1) *Internal decay.* When the preservative in the sapwood is shallow in depth, fungi may gain access through a check or injury to attack the untreated inner sapwood and the heartwood. Pine poles are particularly susceptible to internal decay if not thoroughly treated. Deep separations (checks), occurring after treatment, or woodpecker holes expose untreated wood to internal decay. Occasionally deep-seated infection in seasoned poles is not killed during the treating process and continues to grow, resulting in premature reduction of strength.

(2) *Loss of strength*. Hollow heart exists to some extent in almost all poles; it may be only from the butt up, or from the top down, or go all the way through. The load-supporting ability is reduced in proportion to the hollow area, just as it is for surface rot (as shown in figure C-3). However, due to the location of the affected area, the reduction of strength in bending is less than for surface rot. Because it is hidden, the uncertainty as to the extent of hollow heart may lead to dangerous conditions. If the hollow heart shown in figure C-3 is combined with the surface deterioration of figure C-2 (and this does happen), there is no remaining strength.



Unseen heart-rot at center of pole reduces pole strength

Figure C-3. Twelve-inch (300-millimeter) pole with 4-inch (100-centimeter) radial heart-rot